**<u>IN THE CLAIMS:</u>**

1. (CANCELLED)

2. (CURRENTLY AMENDED) A method of automatically calibrating a water distribution model of a water distribution network, comprising the steps of:

(A) selecting calibration parameters including link status and one or more of, pipe roughness and junction demand;

(B) collecting field observed data including a pipe flow measurement and a junction pressure measurement for at least one point in the water distribution network, and including corresponding loading conditions and boundary conditions that existed in the network when said field observed data was collected and passing such information to a genetic algorithm module;

(C) generating at said genetic algorithm module a population of calibration solutions that comprise a set of calibration results, using a genetic algorithm;

(D) running multiple hydraulic simulations of each solution to obtain a set of predictions of pipe flows and junction pressures at selected points in the network, corresponding to the loading conditions and associated boundary conditions when the field observed data was collected;

(E) performing a calibration evaluation including:
computing a goodness-of-fit value for each calibration solution based upon differences between field observed values and said predictions; ~~and~~

(F) repeating steps (C) through (E) until a user-selected desired goodness-of-fit value is obtained resulting in a corresponding calibration solution for calibrating a water distribution model<u>; and</u> ~~.~~

<u>(G) providing the corresponding calibration solution</u>.

3. (PREVIOUSLY PRESENTED) The method of automatically calibrating a water distribution model as defined in claim 2, including the further steps of:

(A) prior to passing said field observed data to said genetic algorithm module, selecting a weighting function for at least one of said field observed data measurements, said weighting function formulated as a weighting factor of observed pressure heads and flows;

(B) selecting as said weighting factor one of a linear, square, square root or log function of the ratio of individual value for flow or hydraulic pressure to a sum of the observed values of flows or hydraulic pressures; and

(C) applying said weighting function to said field observed data when running said calibration evaluation to determine said goodness-of-fit value.

4. (PREVIOUSLY PRESENTED) The method of automatically calibrating a water distribution model, as defined in claim 2, including the further step of:

selecting as said loading condition, at least one water demand loading at a predetermined time of day, corresponding to a time of day when a field observed data measurement has been made.

5. (ORIGINAL) The method of automatically calibrating a water distribution model, as defined in claim 4, including the further step of selecting multiple loading conditions representing demand loading at various times of day when field observed data measurements have been made.

6. (PREVIOUSLY PRESENTED) The method of automatically calibrating a water distribution model as defined in claim 2 wherein said boundary conditions include water storage tank levels, pressure control valve settings and pump operation speeds.

7. (PREVIOUSLY PRESENTED) The method of automatically calibrating a water distribution model as defined in claim 2 including the further step of:

after said desired goodness-of-fit value and corresponding calibration solution is obtained, making manual adjustments to this information for said water distribution model calibration.

8. (PREVIOUSLY PRESENTED) The method of automatically calibrating a water distribution network model as defined in claim 2, including the further step of performing a sensitivity analysis by varying model input parameters over a predetermined range and observing the response thereto of said model.

9. (ORIGINAL) The method of automatically calibrating a water distribution network model as defined in claim 8 including the further step of adjusting the collection of field observed samples based upon the results of said sensitivity analysis.

10. (CURRENTLY AMENDED) A computer readable medium containing executable program instructions for automatically calibrating a water distribution model of a water distribution network that has links that include pipes and junctions, the executable program instructions comprising program instructions for:

(A) generating a graphic user interface by which ~~the~~ a user may enter data concerning field observed data, demand alternatives and other information for the network;

(B) a calibration module configured to produce calibration information for a water distribution model constructed from user-selected calibration parameters that include at least one of pipe roughness, junction demand information, roughness groups, and link status;

(C) a genetic algorithm module coupled to said calibration module and said user interface that receives information about said calibration parameters, and user-entered field observed data, including field data that include calibration target data and boundary data, said genetic algorithm being configured to produce a population of calibration solutions, and said graphic user interface further being configured to allow ~~a~~ the user to select at least one of goodness-of-fit criteria, a weighting function, and one or more genetic algorithm parameters; and

(D) a hydraulic network simulation module communicating with said genetic algorithm module such that calibration solutions generated by said genetic algorithm module can be run by said hydraulic network simulation module to predict actual behavior of said network, such that predictions are passed back to said calibration module for comparison with field observed data to produce goodness-of-fit values, until a desired goodness-of-fit value satisfying user-selected goodness-of-fit criteria is obtained resulting in a corresponding calibration solution for calibrating a water distribution model;

wherein the corresponding calibration solution is provided for use.

11. (CANCELLED)

12. (PREVIOUSLY PRESENTED) The computer readable medium as defined in claim 10, comprising program instructions for performing the further steps of repetitively computing successive generations of solutions in one or more calibration runs, and calibration solutions are stored for retrieval and evaluation.

13. (PREVIOUSLY PRESENTED) The computer readable medium as defined in claim 10 further comprising:

a database including information regarding water distribution networks for constructing models of said networks, and into which information can be saved.

14. (CURRENTLY AMENDED) The computer readable medium as defined in claim 10 wherein said user interface further allows ~~a~~ the user to enter information regarding alternative demand loadings, representing a demand for water supply at a given point in time, at a given location in the network.

15. (PREVIOUSLY PRESENTED) A method as described in claim 2 wherein link status is a status of being opened or closed of one or more of pipes, valves and, as being on or off for pumps, in the water distribution model of the water distribution network that is being calibrated.

16. (PREVIOUSLY PRESENTED) The method as defined in claim 2 further comprising the step of:

computing a roughness value, roughness multiplier, and identifying link status.

17. (CANCELLED)

18. (CURRENTLY AMENDED) The computer readable medium as defined in claim 10 comprising program instructions for performing the further steps of:

~~terminating~~

pausing a calibration run; ~~to~~

determining~~e~~ intermediate values;

observing the intermediate values by a user~~,~~ and

~~pausing and~~ resuming said calibration run.

19-22. (CANCELLED)

23. (CURRENTLY AMENDED) A computer implemented method, the method comprising:

calibrating a water distribution model wherein model calibration parameters are generated by providing an initial selection of parameters to be determined including link status and one or more of pipe roughness and junction demand to a genetic algorithm module, and performing the steps of:

(A) receiving at said genetic algorithm module, said selected parameters and field observed data, and generating at said genetic algorithm module a calibration solution for said calibration parameters;

(B) receiving said calibration solution at an associated hydraulic simulation module and running a hydraulic simulation of the model using said calibration solution;

(C) producing as a result at said hydraulic simulation module, a set of predictions of junction pressures and pipe flows for nodes in a water distribution model for said calibration solution;

(D) passing said predictions for that calibration solution to an associated calibration module to evaluate how closely the predictions are to field observed data and assigning a goodness of fit value to that calibration solution;

(E) repeating steps A through D a plurality of times and passing the goodness of fit value to a genetic algorithm module for each solution; ~~and~~

(F) calculating at said genetic algorithm module, solutions that correspond with a minimum discrepancy between the simulated predictions and the observed data to obtain a desired set of calibration parameters for use in calibrating a water distribution model; and

(G) providing the desired set of calibration parameters.

24. (PREVIOUSLY PRESENTED) The method as defined in claim 23 including the further step of performing a sensitivity analysis by varying parameters for a roughness, demand and link status over a predetermined range and observing the relative change in the model response thereto.

25. (PREVIOUSLY PRESENTED) The method as defined in claim 23 including the further step of matching the model to historical field conditions.

26. (PREVIOUSLY PRESENTED) The method as defined in claim 23 including the further step of assigning a selected group of pipes to be in a particular roughness group and assigning a roughness calibration variable being one of a roughness coefficient or a roughness coefficient multiplier as the roughness calibration parameter for that roughness group.

27. (NEW) The method of automatically calibrating a water distribution network model as defined in claim 2 wherein the step of providing further comprises making the corresponding calibration solution available to a user.

28. (NEW) The method of automatically calibrating a water distribution network model as defined in claim 2 wherein link status indicates whether valves, pipes or pumps are open or closed.

29. (NEW) A computer implemented method, the method comprising:

calibrating a water distribution model wherein a plurality of model calibration parameters are generated by providing an initial selection of parameters to be determined to a genetic algorithm module, the initial selection of parameters including both pipe and valve operational state and junction demand, and performing steps of:

(A) receiving at said genetic algorithm module, said selected parameters and field observed data, and generating at said genetic algorithm module a calibration solution for said calibration parameters;

(B) receiving said calibration solution at an associated hydraulic simulation module and running a hydraulic simulation of the model using said calibration solution;

(C) producing as a result at said hydraulic simulation module, a set of predictions of junction pressures and pipe flows for nodes in a water distribution model for said calibration solution;

(D) passing said predictions for that calibration solution to an associated calibration module to evaluate how closely the predictions are to field observed data and assigning a goodness of fit value to that calibration solution;

(E) repeating steps A through D a plurality of times and passing the goodness of fit value to a genetic algorithm module for each solution;

(F) calculating at said genetic algorithm module, solutions that correspond with a minimum discrepancy between the simulated predictions and the observed data to obtain a desired set of calibration parameters for use in calibrating a water distribution model; and

building a calibrated water distribution model using the desired set of calibration parameters.